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BIOLOGY AND PARASITIZATION OF *DINARMUS VAGABUNDUS* (HYMENOPTERA : PTEROMALIDAE)

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The potentiatiality of using *Dinarmus vagabundus* (Timberlake) (Hymenoptera : Pteromalidae) as biological control agents have been explored in laboratory studies. Its biology has been studied during summer and winter seasons. Fecundity and percentage of parasitization were always higher in summer. It has also been observed that the parasitization percentage showed significant variation on different species of stored legume seeds infested by *Callosobruchus chinensis*. It was maximum on cow pea (27.01% parasitization) during summer followed by green gram, red gram and chick pea. The parasitization potentiality of *D. vagabundus* did not correspond to the high rate of reproduction but the capacity to penetrate the stored seeds and kill/paralyze the larva/pupa of *C.chinensis*.

Key words : Biology, parasitization, *Dinarmus vagabundus*.

INTRODUCTION

The assessment of occurrence, distribution and abundance of pest and parasitoids are essential prerequisites to rational control programmers. The concept of bio-control is easy and economic to deliver through seeds. In storage, the seed treatment with bio-control agents can easily be applied by the seed producers at the time of their seed processing. The cost of such treatment is extremely low and practically negligible whereas the benefits are several folds. In view of these advantages, research on developing further products of bio-control agents and their methods of application is sure to pay high dividends to researchers, farmers, commercial firms as well as the society. Therefore, a fillip to research in this line is an urgent need in our country.

MATERIALS AND METHODS

Both males and females of *Callosobruchus chinensis* were kept at a ratio of 1: 1 in glass tubes for mating. A large number of mated females were introduced in different petri-dishes (11.5cm.diameter) containing fresh seeds of green gram (*Vigna radiata*) and covered by transparent lids. During summer, larval-pupal development stage of *C. chinensis* progressed upto 8 to 22 days and similarly during winter it was recorded upto 24 - 42 day. The seeds containing larvae and pupae of host insects, the per cent parasitization by the parasitoid, *D. vagabundus* has been studied. The virgin females of *D. vagabundus* (less than 24 hours old) were kept with the virgin males in another separate set of vials for mating. The males became excited in the presence of females within a minute. Courtship behavior lasted for 20-60 seconds. After mating, the females and males (one pair/replication) were transferred to the petri dish containing the larvae/pupae of host insects inside the pulse seeds. Honey solution diluted within water in 1:1 ratio and was provided on wax paper strips inside the petri dish as their food. Few mated females of the parasitoid before oviposition (within 12-24 hours of mating) were killed in ethanol 50%+ glycerin 50% and their abdomens were mounted permanently and

the eggs present inside the abdomen were viewed with the help of compound microscope to count the average fecundity. Same procedure was followed for both sets of experiments continued in summer and winter seasons.

One hundred numbers each of *C. chinensis* infested green gram seeds with 8 to 22-day-old (during summer) and 16 to 32-day-old (during winter) larval-pupal stage were taken in the petri dish and 2 pairs of mated female parasitoids were transferred each inside the petri-dish to oviposit on the host larvae or pupae before their death. After emergence of adult parasitoid the developmental period (egg to adult) was recorded. The male and female parasitoids after emergence were taken in separate test tube from the petri dish with the help of aspirator and their longevity and sex ratio were recorded.

Callosobruchus chinensis infested green gram seeds (single pair /experiment) were taken inside the petri dish and mated parasitoids (male: female = 1:1) were introduced inside the petri dish for their oviposition till their death. After completion of the parasitization of the host insects the dead parasitoid were removed from the petriplates. Then the seeds were dissected out to observe the number of parasitized larvae and pupae under a simple stereo binocular microscope. The per cent parasitization per female was calculated during both summer and winter seasons under laboratory storage conditions using the formula given below:

$$\text{Per cent parasitization} = \frac{\text{Total number of parasitized larvae / pupae of the host}}{\text{Total number of larvae and pupae of the host}} \times 100$$

Each experiment was replicated four times and the data obtained were statistically analyzed. The above mentioned methods were adopted as described by Islam (1995) with some modifications because the parasitoid, *D. vagabundus* is gregarious larval-pupal ecto-parasitoid of bruchid pests.

RESULTS AND DISCUSSION

Biology : Being a larval-pupal parasitoid of *C. chinensis*, the females of *D. vagabundus* pierced the seed coat of pulses by its sharp and pointed ovipositor. After access to larva/pupa the female oviposited on the outer surface of the larval integument. Single to several eggs were laid on a single host larva/pupa. The adult males were polygamous and smaller in size than that of female parasitoid. The courtship duration during summer and winter was recorded as 56.23 ± 6.33 and 47.73 ± 8.47 seconds, respectively. The mean mating duration was 14.14 ± 1.47 seconds during summer and 13.79 ± 1.04 seconds during winter. The fecundity was studied during summer and winter seasons only. It was higher during summer (42.8 ± 2.89) than in winter (38.5 ± 1.47). The time taken for completion of life cycle (egg-adult) during winter was 51.71 ± 2.43 days which was much longer than in summer (19.14 ± 2.31 days). The life span of adult females was always longer than that of males in every season. The female survived for 7.71 ± 1.11 days and 11.88 ± 2.05 days during summer and winter respectively. The male life span was recorded 5.55 ± 0.75 days during summer and 9.88 ± 2.57 days during winter. The sex ratio (male: female) was 1: 2.07 during summer and 1:1.55 during winter (Table I).

Table I : Biology of *D. vagabundus* and temperature and relative humidity of rearing room. (Mean of 3 years, 1999-2001)

Biology	Seasons		
	Summer	Winter	Average of seasons
Courtship duration (second)	56.26 ± 16.33 (40-73)	47.73 ± 18.47 (29-64)	51.98±17.4 (34.5-68.5)
Mating duration (second)	14.11 ± 1.47 (11.5-16.0)	13.79 ± 1.04 (11.0-15.0)	3.95±1.25 (11.25-15.5)
Fecundity/ female (number)	42.8 ± 2.89 (38-47)	38.5 ± 1.47 (31-42)	40.65±2.18 (34.5-44.5)
Life cycle (egg – adult) (day)	19.14 ± 2.31 (16-22)	51.71 ± 2.43 (48-54)	35.42±2.37 (32-38)
Longevity of adult male (day)	5.55 ± 0.75 (4-7)	9.88 ± 1.57 (7-12)	7.71±1.16 (5.5-9.5)
Longevity of adult female (day)	7.71 ± 1.11 (7-9)	11.88 ± 2.05 (8-15)	9.79±1.58 (7.5-12)
Sex ratio (male : female)	1:2.07	1 : 1.55	1 : 181
Average temperature ^{O}C	28.05	20.00	
Average R.H. (%)	64.63	63.92	

The values are the mean ± S.D. Figures in the parenthesis are the ranges

Percentage of parasitization : The number of adults emerged out of a single green gram, Bengal gram, red gram and cowpea seed each infested with single larva/pupa of *C. chinensis* was 2.71 ± 1.52, 2.96 ± 0.98, 3.01 ± 1.08, and 3.66 ± 1.29 respectively during summer. The per cent parasitization the larva and pupa of *C. chinensis* by *D. vagabundus* on green gram, bengal gram, cowpea and red gram stored pulses during summer and winter is provided in the Table II. The mean parasitization (%) of *D. vagabundus* on host pulses was always higher during summer (20.82±4.65). Mean per cent parasitization of two seasons on 4 different species of pulses could be arranged in the followed descending order: cowpea (25.90%) > red gram (20.38%) > green gram (17.96%) > chick pea (15.52%). The female parasitoid with the help of its sharp and pointed ovipositor reaches and oviposits on the surface of host's larvae or pupae (Dhir, 1976 and Islam, 1995). The courtship (seconds) was recorded to be four time prolonged than the mating. Mating lasted for 15-45 seconds and male can mate with up to 38 females as observed by Kundra (1976).

The highest fecundity (47) has been recorded during summer and lowest during the winter. Dhir (1977) observed 9-26 eggs/female in his study although 'the actual count of fecundity is a difficult task' as emphasized by Islam (1995). The fecundity of *D. vagabundus* has the high rate of reproduction on the host. Temperature and relative humidity have direct impact on the biology. It has been observed in France that continuous brooding, semi-natural temperature and photoperiod cause the simultaneous occurrence of diapausing and non-diapausing larval stage in the spring season (Fabres &

Table II : Parasitization and emergence of adult *D. vagabundus* from a single larva/pupa of *C. chinensis*. (Average of 3 years, 1999-2001)

Pulse	Parasitization (%)			No. of adult / larva or pupa
	Summer	Winter	Average of two seasons	
Green gram	18.22 ± 5.26 (12 – 25)	16.77 ± 3.04 (13 – 21)	17.49 ± 4.15 (12.5 – 23)	2.71 ± 1.52 (1-4)
Bengal gram	16.33 ± 2.54 (13-19)	14.72 ± 2.54 (11 – 17)	15.52 ± 2.34 (12 – 18)	2.96 ± 0.98 (1-5)
Red gram	2172 ± 6.02 (16-28)	19.04 ± 4.16 (14 – 24)	20.38 ± 5.09 (15 – 26)	3.01 ± 1.08 (1-6)
Cowpea	27.01 ± 4.79 (22-32)	24.79 ± 3.48 (20 – 29)	25.9 ± 4.13 (21 – 30.5)	3.66 ±1.21 (1-7)
Mean	20.82 ± 4.65 (12-32)	18.83 ± 3.30 (11-29)	19.82 ± 3.92 (11.5-30.5)	3.08 ± 1.91 (1-7)

The values represent mean ± S.D. and the ranges in parenthesis.

Reymount, 1991). The emergence of adult from a single seed varied with different species of pulses. The potentiality of parasitization has been observed to vary with different species of stored pulses. On the average, the degree of parasitization is higher in summer when the average temperature is 28^{0}C and R.H. is 64.6 %, which seem to be the most favourable for their parasitization.

All the biological parameters namely courtship, copulation, fecundity and sex ratio (male : female) show higher values during summer and lower during winter season. Adult's longevity of female always greater than that of the adult male during both the seasons. The developmental periods were also prolonged during winter. The temperature and relative humidity directly influenced their biological activities. Dhir (1977) observed the variation of egg laying at different sets of temperature and R.H. (%). *D. vagabundus* is not very frequently recorded in nature, it is regarded as an important larval-pupal ecto-parasitoid of bruchid. In the north eastern part of India, this parasitoid may effectively be utilized as bio-control agents for suppression of the bruchid pest of pulses.

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